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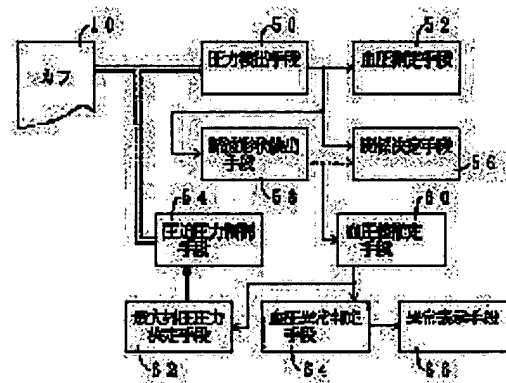
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(54) AUTOMATIC BLOOD PRESSURE MEASURING DEVICE EQUIPPED WITH BLOOD PRESSURE ESTIMATING FUNCTION

(57)Abstract:

PURPOSE: To estimate the blood pressure of an organism prior to the measurement of the blood pressure during the slow pressure lowering period of a cuff.

CONSTITUTION: The shape of the pulse wave and the relationship between the pressing pressure PC of a cuff 11 at the time of the occurrence of the pulse wave and the blood pressure of an organism are determined by a relationship determining means 56, while the blood pressure is estimated by a blood pressure estimating means 60 on the basis of the shape of the actual pulse wave detected by a pulse-wave shape detecting means 58 during the rapid pressure rising period of the cuff 10 from the above relationship and the pressing pressure PC of the cuff 10 at the time of the occurrence of the pulse wave. Thus, the blood pressure of the organism during the rapid pressure rising period of the cuff prior to the slow pressure lowering period thereof is estimated, and an approximate blood pressure of the organism can be quickly obtained.



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CLAIMS

[Claim(s)]

[Claim 1] Automatic blood-pressure-measurement equipment which performs blood pressure measurement in a period which makes the pressure of compression pressure force of a cuff to a living body characterized by providing the following lower gently at predetermined speed A pressure detection means to be automatic blood-pressure-measurement equipment equipped with a blood-pressure value presumption function to presume this living body's blood-pressure value in a rapid pressure-up period of a cuff before pressure lowering of this predetermined speed, and to detect compression pressure force of said cuff A pulse wave configuration detection means to detect a configuration of a pulse wave generated in said cuff A related decision means to determine beforehand relation of a living body proper between a configuration of a pulse wave which changes in connection with compression pressure force of said cuff, compression pressure force of a cuff at the time of generating of this pulse wave, and said living body's blood-pressure value based on a configuration of a pulse wave obtained on the occasion of said blood pressure measurement, and said living body's blood-pressure value A blood-pressure value presumption means to presume said living body's blood-pressure value from relation determined by this relation decision means based on a configuration of an actual pulse wave detected by said pulse wave configuration detection means in a rapid pressure-up period of said cuff, and compression pressure force of a cuff at the time of generating of this pulse wave

[Claim 2] A configuration of said pulse wave is what is quantitatively expressed with two or more kinds of waveform analysis values defined beforehand. Said related decision means It is said thing which determines two or more two or more kinds of relation for every waveform analysis value of a class. Said blood-pressure value presumption means this - - automatic blood-pressure-measurement equipment equipped with a blood-pressure value presumption function of claim 1 which is what presumes said living body's blood-pressure value based on these two or more blood-pressure values while computing two or more blood-pressure values from two or more kinds of relation.

[Claim 3] Automatic blood-pressure-measurement equipment equipped with the blood-pressure value presumption function of claim 1 which is what includes further a maximum pressure-up pressure decision means determine the maximum pressure-up pressure of said rapid pressure-up period based on a blood-pressure value presumed by said blood-pressure value presumption means, and a compression-pressure force-control means make **** pressure lowering of this cuff start when a pressure of said cuff reaches the maximum pressure-up pressure determined by this maximum pressure-up pressure decision means.

[Claim 4] Automatic blood-pressure-measurement equipment equipped with the blood-pressure value presumption function of claim 1 which is what includes further an abnormality judging means in blood pressure judge said living body's abnormalities in blood pressure by comparing a blood-pressure value presumed by said blood-pressure value presumption means with a decision-criterion value set up beforehand, and an abnormality display means display abnormalities in blood pressure when a living body's abnormalities in blood pressure are judged by this abnormality judging means in blood pressure.

[Claim 5] Automatic blood-pressure-measurement equipment which performs blood pressure measurement in a period which makes the pressure of compression pressure force of a cuff to a living body characterized by providing the following lower gently at predetermined speed A pressure detection means to be automatic blood-pressure-measurement equipment equipped with a blood-pressure value presumption function to presume this living body's blood-pressure value in a rapid pressure-up period of a cuff before pressure lowering of this predetermined speed, and to detect compression pressure force of said cuff A pulse wave detection means to detect a configuration of a pulse wave generated in said cuff A pulse wave amplitude cuff pressure storage means to memorize a pressure of a cuff when amplitude of a pulse wave detected by this pulse wave detection means and its pulse wave occur An envelope decision means to determine an envelope showing relation between amplitude of two or more pulse waves detected by said pulse wave detection means in a rapid pressure-up period of said cuff, and a pressure of a cuff at the time of generating of two

or more of these pulse waves, and a blood-pressure value presumption means presume said living body's blood-pressure value from relation set up beforehand based on an envelope determined by this envelope decision means

[Claim 6] Automatic blood-pressure-measurement equipment equipped with the blood-pressure value presumption function of claim 5 which is what includes further a maximum pressure-up pressure decision means determine the maximum pressure-up pressure of said rapid pressure-up period based on a blood-pressure value presumed by said blood-pressure value presumption means, and a compression-pressure force-control means make **** pressure lowering of this cuff start when a pressure of said cuff reaches the maximum pressure-up pressure determined by this maximum pressure-up pressure decision means.

[Claim 7] Automatic blood-pressure-measurement equipment equipped with the blood-pressure value presumption function of claim 5 which is what includes further an abnormality judging means in blood pressure judge said living body's abnormalities in blood pressure by comparing a blood-pressure value presumed by said blood-pressure value presumption means with a decision-criterion value set up beforehand, and an abnormality display means display abnormalities in blood pressure when a living body's abnormalities in blood pressure are judged by this abnormality judging means in blood pressure.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to automatic blood-pressure-measurement equipment equipped with the blood-pressure value presumption function to presume a blood-pressure value at the time of the rapid pressure up of a cuff, in advance of measurement of the blood-pressure value at the time of cuff **** pressure lowering of automatic blood-pressure-measurement equipment.

[0002]

[Description of the Prior Art] The automatic blood-pressure-measurement equipment which measures a living body's blood-pressure value automatically is known. With such automatic blood-pressure-measurement equipment, after the pressure up of the compression pressure force of the cuff to a living body is usually quickly carried out until the blood flow in an artery was prevented, blood pressure measurement is performed in the period the compression pressure force of a cuff is made to lower the pressure of gently at the speed which is predetermined speed, 2 [for example,], thru/or a 3 mmHg/sec degree. As a method of this blood-pressure decision, the oscillograph metric method and the Korotkoff-sounds method are learned well. By the oscillograph metric method, pressure vibration generated in a cuff in the period a cuff is made to lower the pressure of gently is detected as a pulse wave, and a highest-blood-pressure value and a lowest-blood-pressure value are determined based on change of the magnitude of the pulse wave amplitude. Moreover, by the Korotkoff-sounds method, a microphone detects, the blood-flow sound, i.e., the Korotkoff sounds, generated from an artery in the period a cuff is made to lower the pressure of gently, and a highest-blood-pressure value and a lowest-blood-pressure value are determined based on generating and disappearance of the Korotkoff sounds. Since the amount of pressure variation of the cuff which is equivalent to the recurrence interval of a pulse wave or Korotkoff sounds by these blood-pressure value decision methods influences the accuracy of measurement, with automatic blood-pressure-measurement equipment, it is highly precise, and in order to measure a blood-pressure value, blood pressure measurement is automatically performed in the period a cuff is made to lower the pressure of gently.

[0003]

[Problem(s) to be Solved by the Invention] By the way, with the above-mentioned conventional automatic blood-pressure-measurement equipment, since blood pressure measurement is performed in the period a cuff is made to lower the pressure of gently, in order to acquire a blood-pressure value, needing the time amount for about 20 seconds is not avoided. For this reason, in advance of the blood pressure measurement in the **** pressure-lowering period of such a cuff, there was a defect which cannot know a living body's blood-pressure value quickly. For example, to get to know a living body's blood-pressure value quickly in advance of the blood pressure measurement in the **** pressure-lowering period of a cuff, like [in the case where it is forced quick decision to an emergency patient, and the case of determining pressure-up ***** only with a high predetermined value rather than a living body's highest-blood-pressure value in the rapid pressure up of a cuff], although it may be rough is desired.

[0004] The place which succeeds in this invention against the background of the above situation, and is made into the purpose is to offer automatic blood-pressure-measurement equipment equipped with the blood-pressure value presumption function in which a living body's blood-pressure value can be presumed in advance of the blood pressure measurement in the **** pressure-lowering period of a cuff.

[0005]

[The 1st means for solving a technical problem] The place made into the summary of this invention for attaining this purpose In the automatic blood-pressure-measurement equipment which performs blood pressure measurement in the period which makes the pressure of the compression pressure force of the cuff to a living body lower gently at predetermined speed A pressure detection means to be automatic blood-pressure-measurement equipment equipped with

the blood-pressure value presumption function to presume a living body's blood-pressure value in the rapid pressure-up period of the cuff before pressure lowering of the predetermined speed, and to detect the compression pressure force of the (a) aforementioned cuff, (b) A pulse wave configuration detection means to detect the configuration of the pulse wave generated in said cuff, (c) It is based on the configuration of the pulse wave obtained on the occasion of said blood pressure measurement, and said living body's blood-pressure value. A related decision means to determine beforehand the relation of the living body proper between the configuration of the pulse wave which changes in connection with the compression pressure force of said cuff, the compression pressure force of the cuff at the time of generating of the pulse wave, and said living body's blood-pressure value, (d) A blood-pressure value presumption means to presume said living body's blood-pressure value from the relation determined by the related decision means based on the configuration of the actual pulse wave detected by said pulse wave configuration detection means in the rapid pressure-up period of said cuff, and the compression pressure force of the cuff at the time of generating of the pulse wave It is in containing.

[0006]

[Function] If it does in this way, it is based on the configuration of the pulse wave obtained on the occasion of said blood pressure measurement by the related decision means, and said living body's blood-pressure value. While the relation of the living body proper between the configuration of the pulse wave generated in a cuff, the compression pressure force of the cuff at the time of generating of the pulse wave, and a living body's blood-pressure value is determined beforehand, with a blood-pressure value presumption means A living body's blood-pressure value is presumed based on the configuration of the actual pulse wave detected in the rapid pressure-up period of a cuff by the pulse wave shape memory means from the relation, and the compression pressure force of the cuff at the time of generating of the pulse wave.

[0007]

[The 1st effect of the invention] therefore, according to the automatic blood-pressure-measurement equipment of this invention, from the relation of the living body proper beforehand asked between the configuration of the pulse wave generated in a cuff, the compression pressure force of the cuff at the time of generating of the pulse wave, and a living body's blood-pressure value A living body's blood-pressure value is presumed based on the waveform analysis value of the pulse wave of at least one beat obtained in the rapid pressure-up period of the cuff before the **** pressure-lowering period of a cuff, and the pressure of the cuff at the time of the generating, and a rough living body's blood-pressure value can be acquired quickly.

[0008] The configuration of said pulse wave is what is quantitatively expressed with two or more kinds of waveform analysis values defined beforehand suitably here. Said related decision means While two or more two or more kinds of relation is determined for every waveform analysis value of a class and said blood-pressure value presumption means computes [said] two or more blood-pressure values from two or more kinds of the relation, based on two or more of the blood-pressure values, said living body's blood-pressure value is presumed. If it does in this way, since a living body's blood-pressure value will be presumed from two or more blood-pressure value determined from many sides from two or more kinds of relation, the reliability of the blood-pressure value presumed is raised. As the above-mentioned waveform analysis value, it is Slope which shows the maximum inclination of the amplitude value b of a pulse wave, and the standup portion of a pulse wave. A value and %MAP of the configuration of a pulse wave which sharpens and shows condition It starts and the peak index PI value which shows the rate to % value and the pulse wave period between the maximum peak and its following peak which shows the rate to a value and the pulse wave period of the build up time of a pulse wave is used.

[0009] Moreover, a maximum pressure-up pressure decision means to determine the maximum pressure-up pressure of said rapid pressure-up period suitably based on the blood-pressure value presumed by said blood-pressure value presumption means, and a compression pressure force-control means to make **** pressure lowering of a cuff start when the pressure of said cuff reaches the maximum pressure-up pressure are included further. If it does in this way, since the pressure up of the cuff will be carried out to a value only with a predetermined value higher than necessity and sufficient value, i.e., a living body's highest-blood-pressure value, by the pressure up of the cuff being carried out to the maximum pressure-up pressure in the rapid pressure-up period, carrying out the pressure up of the cuff to unnecessarily high **, or carrying out a re-pressure up is canceled, and the burden to a living body is mitigated.

[0010] Moreover, an abnormality judging means in blood pressure to judge said living body's abnormalities in blood pressure by comparing suitably the blood-pressure value presumed by said blood-pressure value presumption means with the decision-criterion value set up beforehand, and an abnormality display means to display the abnormalities in blood pressure when a living body's abnormalities in blood pressure are judged by the abnormality judging means in blood pressure are included further. If it does in this way, in the rapid pressure-up period, a living body's blood-pressure

value can know whether it is unusual, and the decision quick about the medical measures against a living body of a cuff will be attained.

[0011]

[The 2nd means for solving a technical problem] Moreover, the place made into the summary of other invention for attaining said purpose In the automatic blood-pressure-measurement equipment which performs blood pressure measurement in the period which makes the pressure of the compression pressure force of the cuff to a living body lower gently at predetermined speed It is automatic blood-pressure-measurement equipment which presumes a living body's blood-pressure value in the rapid pressure-up period of the cuff before pressure lowering of the predetermined speed, and is (a). A pressure detection means to detect the compression pressure force of said cuff, (b) A pulse wave detection means to detect the pulse wave generated in said cuff, and (c) A pulse wave amplitude cuff pressure storage means to memorize the pressure of a cuff when the amplitude and pulse wave of the pulse wave detected by the pulse wave detection means occur, (d) An envelope decision means to determine the envelope showing relation with the pressure of a cuff when two or more the amplitude and two or more pulse waves of a pulse wave which were detected by the pulse wave detection means in the rapid pressure-up period of said cuff are detected, (e) It is in including a blood-pressure value presumption means to presume said living body's blood-pressure value based on the envelope determined by the envelope decision means from the relation set up beforehand.

[0012]

[Function] If it does in this way, the envelope showing relation with the pressure of a cuff when two or more the magnitude and two or more pulse waves of a pulse wave which were detected by the pulse wave detection means in the rapid pressure-up period of a cuff are detected will be determined by the envelope decision means, and said living body's blood-pressure value will be presumed by the blood-pressure value presumption means based on the envelope determined by the envelope decision means from the relation to which it was set beforehand.

[0013]

[The 2nd effect of the invention] Therefore, according to the automatic blood-pressure-measurement equipment of this invention, a living body's blood-pressure value is presumed based on the envelope obtained in the rapid pressure-up period of the cuff before the **** pressure-lowering period of a cuff, and a rough living body's blood-pressure value can be acquired quickly.

[0014] Here, a maximum pressure-up pressure decision means to determine the maximum pressure-up pressure of said rapid pressure-up period suitably based on the blood-pressure value presumed by said blood-pressure value presumption means, and a compression pressure force-control means to make **** pressure lowering of a cuff start when the pressure of said cuff reaches the maximum pressure-up pressure are included further. If it does in this way, since the pressure up of the cuff will be carried out to a value only with a predetermined value higher than necessity and sufficient value, i.e., a living body's highest-blood-pressure value, by the pressure up of the cuff being carried out to the maximum pressure-up pressure in the rapid pressure-up period, carrying out the pressure up of the cuff to unnecessarily high **, or carrying out a re-pressure up is canceled, and the burden to a living body is mitigated.

[0015] Moreover, an abnormality judging means in blood pressure to judge said living body's abnormalities in blood pressure by comparing suitably the blood-pressure value presumed by said blood-pressure value presumption means with the decision-criterion value set up beforehand, and an abnormality display means to display the abnormalities in blood pressure when a living body's abnormalities in blood pressure are judged by the abnormality judging means in blood pressure are included further. If it does in this way, in the rapid pressure-up period, a living body's blood-pressure value can know whether it is unusual, and the decision quick about the medical measures against a living body of a cuff will be attained.

[0016]

[Example] The automatic blood-pressure-measurement equipment hereafter equipped with the blood-pressure value presumption function which is one example of this invention is explained to details based on a drawing.

[0017] In drawing 1, the cuff 10 wound around it in order to press a living body's overarm etc. is constituted by holding expansion bag 10a constituted by elastic membrane like a rubber sheet or plastic sheeting etc. in armband 10b which cannot be expanded and contracted. Expansion bag 10a of this cuff 10 is connected with the pressure sensor 12 equipped with the semiconductor pressure sensing element, the electromotive air pump 14, and the pressure control valve 16 through pneumatic piping 18. This pressure control valve 16 controls the compression pressure force of a cuff 10 according to the command from an arithmetic sequence unit 26, and is functioning as the below-mentioned compression pressure force-control means 54.

[0018] The above-mentioned pressure sensor 12 corresponds to the below-mentioned pressure detection means 50, detects the pressure in a cuff 10, and supplies the pressure signal SP showing the pressure to a low pass filter 20, the 1st

band pass filter 22, and the 2nd band pass filter 23. A low pass filter 20 discriminates from the dc component contained in the pressure signal SP, and is the pressure (static pressure) PC of a cuff 10. It takes out and outputs to A/D converter 24 as a cuff pressure signal SK. Moreover, the 1st band pass filter 22 discriminates from 1 thru/or the 10Hz frequency component contained in the pressure signal SP, and outputs a pulse wave component to A/D converter 24 as ejection and a pulse wave signal SM 1. In the cuff 10 wound around a living body's overarm etc., the pressure fluctuation which synchronized with the heartbeat based on pulsation of an artery occurs. And the 2nd band pass filter 23 discriminates from 0.5 thru/or the 20Hz frequency component contained in the pressure signal SP, and outputs a pulse wave component to A/D converter 24 as ejection and a pulse wave signal SM 2. The 1st band pass filter 22 It is under [**** pressure variation / of the pressure of the cuff 10 for blood pressure measurement / (2 thru/or 3 mm/Hg)] setting. As opposed to having the narrow frequency characteristic aiming at noises, such as a motion artifact noise, being uninfluential and taking out, pressure vibration, i.e., the pulse wave amplitude, generated in a cuff 10 synchronizing with a heartbeat The 2nd band pass filter 23 is equipped with the comparatively large frequency characteristic aiming at taking out correctly the pressure pulse wave generated in an artery during maintenance of the pressure of the cuff 10 for extracting a more exact pulse wave, and the pulse wave of the same configuration from a cuff 10. In addition, the multiplexer which carries out time sharing of the three above-mentioned kinds of input signals is contained in above-mentioned A/D converter 24, and it has the function which carries out A/D conversion of these three kinds of input signals in juxtaposition. The 1st band pass filter 22 of the above and the 2nd band pass filter 23 support the below-mentioned pulse wave configuration detection means 58.

[0019] An arithmetic sequence unit 26 is the so-called microcomputer including CPU28, RAM30, ROM32, the output interface 34, and the interface 36 for a display. CPU28 The signal inputted from A/D converter 24, using the temporary storage function of RAM30 While processing according to the program beforehand memorized by ROM32 and carrying out drive control of an air pump 14 and the pressure control valve 16 through the output interface 34, drive control of the drop 38 is carried out through the interface 36 for a display. This drop 38 is equipped with the ink which can display a numeric value and a wave on space in ink if needed while having the image display board which can display a numeric value and a wave by many pixels. In this example, the above-mentioned drop 38 supports the below-mentioned abnormality display means 66.

[0020] The mode circuit changing switch 40 is operated in order to change measurement mode and continuation supervision mode once, and it supplies alternatively the signal which orders it once measurement mode or continuation supervision mode to CPU28. Moreover, starting / safety switch 42 supplies the signal which orders it starting and a halt by turns for the press actuation of every to CPU28.

[0021] Drawing 2 is a functional block diagram explaining the important section of the control function of the above-mentioned arithmetic sequence unit 26. A pressure detection means 50 to detect the compression pressure force of a cuff 10 in which the automatic blood-pressure-measurement equipment of drawing was wound around some living bodies, A blood-pressure-measurement means 52 to measure a living body's blood-pressure value based on pressure vibration, i.e., change of the magnitude of the amplitude of a series of pulse waves, generated when a cuff 10 is made to carry out **** pressure lowering, If **** pressure lowering is carried out and a blood-pressure value is determined in this **** pressure-lowering period after carrying out a pressure up quickly to the maximum pressure-up pressure which was able to define the compression pressure force of a cuff 10 beforehand at the time of initiation of blood pressure measurement, it has a compression pressure force-control means 54 to release the compression pressure force of a cuff 10. The related decision means 56 determines beforehand the relation of the living body proper between the configuration of the pulse wave generated in a cuff 10, the compression pressure force of the cuff at the time of generating of the pulse wave, and a living body's blood-pressure value based on the configuration of the pulse wave obtained on the occasion of the blood pressure measurement by the blood-pressure-measurement means 52, and said living body's blood-pressure value. The pulse wave configuration detection means 58 detects the configuration of the pulse wave generated in a cuff 10 in the rapid pressure-up period of a cuff 10. The blood-pressure value presumption means 60 presumes a living body's blood-pressure value based on the configuration of the actual pulse wave detected by the pulse wave configuration detection means 58, and the compression pressure force of the cuff 10 at the time of generating of the pulse wave from the above-mentioned relation.

[0022] The configuration of the pulse wave which is the pressure signal generated in a cuff 10 synchronizing with a heartbeat It follows on the compression pressure force of a cuff 10 carrying out sequential change to the high condition near a living body's highest-blood-pressure value, the condition near a mean-blood-pressure value, and the low condition near a lowest-blood-pressure value, and is (a) of drawing 3 . (b) (c) So that it may be shown From there being a property a location, a configuration, etc. of the inclination of a standup, wave-like width of face, and a reflected wave carry out [a property] sequential change It asks for the relation between the configuration of the pulse wave, and a cuff

pressure (blood-pressure value) beforehand, and a blood-pressure value may be presumed based on the actual wave detected in the rapid pressure-up period of a cuff 10 from the relation.

[0023] A maximum pressure-up pressure decision means 62 to determine the maximum pressure-up pressure of said rapid pressure-up period based on the blood-pressure value presumed by said blood-pressure value presumption means 60 is included further, and said compression pressure force-control means 54 makes **** pressure lowering of a cuff 10 start in drawing 2, when the pressure of a cuff 10 reaches the maximum pressure-up pressure. Moreover, an abnormality judging means 64 in blood pressure to judge said living body's abnormalities in blood pressure by comparing the blood-pressure value presumed by said blood-pressure value presumption means 60 with the decision-criterion value set up beforehand, and an abnormality display means 66 to display the abnormalities in blood pressure when a living body's abnormalities in blood pressure are judged by the abnormality judging means 64 in blood pressure are included further.

[0024] Drawing 4 and drawing 5 are the flow charts explaining control actuation of the above-mentioned arithmetic sequence unit 26. At the step SA 1 (hereafter, when the specific step of a flow chart is shown, a "step" is skipped and only a sign is said) of drawing, it is judged based on the signal from starting / safety switch 42 whether starting actuation of automatic blood-pressure-measurement equipment was performed. When decision of this SA1 is denied, you are made to stand by, but when affirmed, in SA2, the pressure up of the cuff 10 is quickly carried out by an air pump 14 and the pressure control valve 16 at the rate of 30 thru/or 40 mmHg/sec degree.

[0025] At continuing SA3, it is cuff pressure PC. For example, it is judged whether the maximum pressure Hasama pressure PCM beforehand set as the 180mmHg degree was reached. By carrying out repeat activation of the two or less SA, when decision of this SA3 is denied, but suspending an air pump 14 in SA4, and controlling the opening of a pressure control valve 16, when affirmed, **** exhaust air of a cuff 10 is started and it is cuff pressure PC. For example, **** pressure lowering is carried out at the speed suitable for the blood pressure measurement which is 2 thru/or 3 mmHg(s)/an about second. And in SA5, it is judged based on the pulse wave signal SM 1 whether one pulse wave was inputted. When decision of this SA5 is denied, repeat activation of the four or less SA is carried out.

[0026] However, when decision of the above SA 5 is affirmed, after the configuration of a pulse wave is memorized in SA6 in the pulse wave configuration storage region 44 of RAM30, in SA7, the blood-pressure value decision routine by the blood-pressure value decision algorithm of an oscillograph metric method is performed, and it is judged whether the decision of a blood-pressure value was completed in SA8. In the **** pressure-lowering period of the cuff 10 in the above-mentioned blood-pressure-measurement period Although the pulse wave amplitude based on the pulse wave signal SM 1 carries out a sequential increment at the beginning as shown in drawing 6, it has after that the property which carries out sequential reduction. In the above-mentioned blood-pressure value decision algorithm For example, a cuff pressure value when the mean-blood-pressure value Pmean and the amplitude of a pulse wave decrease [a cuff pressure value when the highest-blood-pressure value Psys and the amplitude of a pulse wave become / a cuff pressure value when the amplitude of a pulse wave increases rapidly / max] rapidly is the lowest-blood-pressure value Pdia. It carries out and is determined, respectively.

[0027] Although repeat activation of the four or less SA is carried out when the decision in the above SA 8 is denied When affirmed, while each blood-pressure values Psys, Pmean, and Pdia are memorized in SA9 in the blood-pressure value storage region 46 of RAM30, respectively and digital display is carried out to a drop 38 A pressure control valve 16 is opened in SA10, a cuff 10 is exhausted quickly, and pressure by the cuff 10 is canceled. In this example, the above SA 4 which performs blood pressure measurement automatically thru/or S8 support said blood-pressure-measurement means 52.

[0028] And it sets to SA11 and is Flag Fk. It is judged whether the contents are "1." This flag Fk When those contents are "1", it is shown that the relational expression for blood-pressure presumption was determined, and it is cleared by "0" at the time of starting actuation of automatic blood-pressure-measurement equipment. It is related with the living body around whom the cuff 10 is wound in SA12 corresponding to said related decision means 56 since decision of the above SA 11 is denied, and is the configuration, i.e., the waveform analysis value, and cuff pressure PC of a pulse wave at the beginning. Relation with a blood-pressure value is determined. Subsequently, it sets to SA13 and is the above-mentioned flag Fk. The contents are set to "1." In the above SA 12, relational expression is once determined, and it is Flag Fk. If the contents are set to "1", since decision of SA11 will be affirmed in the following cycle, direct SA14 is performed.

[0029] the configuration of each pulse wave memorized in SA6 in the above SA 12 in the pulse wave configuration storage region 44 -- for example, amplitude value b and Slope of a pulse wave A value and %MAP a value -- it starts and a table is carried out by waveform analysis values, such as % value and a peak index PI value, respectively. Here, as shown in drawing 7, the amplitude value b of the above-mentioned pulse wave is the difference (= bottom peak value

DAP of top peak value SAP-) of pulse wave top peak value and bottom peak value, and shows the height configuration of a pulse wave. The above-mentioned Slope value is the maximum (dP/dt) max of the differential value of the standup portion of a pulse wave. It defines by carrying out and the maximum inclination of the standup portion of a pulse wave is shown. the above-mentioned %MAP height a [as opposed to the pulse wave amplitude value b in a value] (= bottom peak value DAP of center-of-gravity value MAP-) of a pulse wave centroids-of-areas location -- comparatively (= $100 \times a/b$) -- ***** -- it defines, the configuration of a pulse wave sharpens and condition is shown. The above-mentioned standup % value is defined as a rate (= $100 \times T_{ds}/T$) of the build up time T_{ds} of the pulse wave to the pulse wave period T (sec), and shows the degree of the bias of a pulse wave. the gap T_{sh} of the maximum peak [as opposed to the pulse wave period T (sec) in the above-mentioned peak index PI value], and its following peak -- comparatively (= $100 \times T_{sh}/T$) -- ***** -- it defines and the location of a reflected wave is shown.

[0030] Since the data in which the relation between each waveform analysis value as shown in drawing 8 by computing a waveform analysis value as mentioned above by the above SA 12, and an actual blood-pressure value (cuff pressure PC at the time of blood pressure measurement) is shown is obtained About the data to each waveform analysis value, they are a waveform analysis value and cuff pressure PC. The waveform analysis value and cuff pressure PC which make it a parameter, relation, i.e., a blood-pressure value, with a blood-pressure value, It is determined as two or more kinds of relation shows drawing 9 , drawing 10 , drawing 11 , drawing 12 , and drawing 13 . In these drawing 9 thru/ or drawing 13 , the curve which makes a parameter blood-pressure values other than the measured blood-pressure value is determined by correcting two or more curvilinear pattern beforehand set up at intervals of mutual [predetermined] for every blood-pressure value based on the measured actual curve. In addition, above-mentioned drawing 9 , drawing 10 , drawing 11 , drawing 12 , and the blood-pressure value in the relation of drawing 13 may be any of a highest-blood-pressure value, a mean-blood-pressure value, and a lowest-blood-pressure value.

[0031] In continuing SA14, it is judged based on the signal from the mode circuit changing switch 40 whether it is continuation supervision mode. When decision of this SA14 is denied, since it is in 1-time measurement mode, this routine is terminated and one or less SA is performed again. However, when the decision in the above SA 14 is affirmed (i.e., when it is continuation supervision mode), it sets to SA15, and it is a timer counter T1. After the contents are cleared, it is judged based on the signal from starting / safety switch 42 whether halt actuation was performed in SA16. When decision of this SA16 is affirmed, this routine is terminated, and one or less SA is performed again.

[0032] However, when decision of SA16 is denied, it sets to SA17, and it is a timer counter T1. After "1" is added to the contents, it sets to SA18, and it is a timer counter T1. It is judged whether the contents reached decision-criterion value T1M set up beforehand. These decision-criterion value T1M are the measurement cycle of the automatic blood-pressure-measurement equipment of this example, for example, are set up within the limits of several minutes thru/ or dozens of minutes. Although 16 or less SA is again performed since decision of the above SA 18 is denied at the beginning, if it is affirmed, a series of routines for presuming a blood-pressure value in the rapid pressure-up period of a cuff 10 in 19 or less SA will be performed.

[0033] At SA19, the rapid pressure up of a cuff 10 is performed like said SA2, and it is judged by SA20 whether one pulse wave occurred. When decision of this SA20 is denied, 19 or less SA is performed again, the rapid pressure up of a cuff 10 is continued, but when affirmed, in SA21, the configuration of a pulse wave is memorized in the pulse wave configuration storage region 44. Subsequently, the blood-pressure value presumption routine of SA22 corresponding to said blood-pressure value presumption means 60 is performed, and a blood-pressure value is presumed based on the configuration of an actual pulse wave from the relation about the living body around whom the cuff 10 was wound determined beforehand. Namely, the waveform analysis value which expresses with SA22 the configuration of the pulse wave memorized in SA21 in the pulse wave configuration storage region 44, For example, amplitude value b and Slope of a pulse wave A value and %MAP A value, a standup % value, Cuff pressure PC when the wave-like pulse wave which these waveform analysis value and its waveform analysis value show from two or more kinds of relation which a peak index PI value is computed and is shown in drawing 9 , drawing 10 , drawing 11 , drawing 12 , and drawing 13 , respectively occurs It is based and two or more blood-pressure values are computed, respectively. According to a predetermined formula, a blood-pressure value is presumed from two or more computed each values.

[0034] In addition, any of a highest-blood-pressure value, a mean-blood-pressure value, and a lowest-blood-pressure value are sufficient as the blood-pressure value which is the parameter of the above-mentioned relation, and the blood-pressure value presumed in said SA22 turns into a blood-pressure value according to the parameter of the above-mentioned relation. Moreover, since calculation of a blood-pressure value is not performed when judged with the above-mentioned formula having the unusual configuration of the inputted pulse wave although the averaging type from the value after excepting a weighted mean value formula, maximum, and the minimum value from an averaging type and the computed each value etc. is used, decision of continuing SA23 will be denied. Each above-mentioned waveform

analysis value is judged according to whether it is decision-criterion within the limits to which this abnormality judging was also set beforehand. If the pulse wave first generated in the rapid pressure-up period of a cuff 10 is normal, since presumption of a blood-pressure value will be performed based on the configuration of the one pulse wave in SA22, decision of continuing SA23 is affirmed.

[0035] Subsequently, in SA23, it is judged whether calculation of the blood-pressure value by the above SA 22, i.e., presumption of a blood-pressure value, was completed. When decision of this SA23 is denied, said 19 or less SA is performed again, and the rapid pressure up of a cuff 10 is continued. However, when affirmed, in SA24 corresponding to said abnormality judging means 64 in blood pressure, it is judged whether they are whether the presumed blood-pressure value is unusual and less than the decision-criterion range set up beforehand. For example, it is judged whether whether the presumed highest-blood-pressure values being 200 or more and 100 or less and the presumed lowest-blood-pressure value are 150 or more and 50 or less.

[0036] When decision of the above SA 24 is affirmed, in SA25, the contents of abnormalities of a blood-pressure value are displayed on a drop 38. In this example, the drop 38 is functioning as said abnormality display means 66. However, if decision of the above SA 24 is denied, it sets to SA26 corresponding to said maximum pressure-up pressure decision means 62, and is the maximum pressure-up pressure PCMR. It is determined. And at SA27, it is cuff pressure PC. The above-mentioned maximum pressure-up pressure PCMR It is judged whether the value (PCMR+alpha) which applied the predetermined additional coverage value alpha was reached. When decision of this SA27 is denied, said 19 or less SA is performed, the rapid pressure up of a cuff 10 is continued, but when affirmed, by performing said four or less SA, it is switched to **** pressure lowering from the rapid pressure up of a cuff, and the usual blood pressure measurement is performed.

[0037] While each relation shown in drawing 9 , drawing 10 , drawing 11 , drawing 12 , and drawing 13 by SA12 corresponding to the related decision means 56, respectively is determined beforehand according to this example, by as mentioned above, SA22 corresponding to the blood-pressure value presumption means 60 cuff pressure PC when the waveform analysis value which shows the configuration of the actual pulse wave detected in the rapid pressure-up period of a cuff 10 with the band pass filters 22 or 23 corresponding to the pulse wave configuration detection means 58 from the relation, and its pulse wave occur -- being based -- a blood-pressure value (a highest-blood-pressure value and a mean-blood-pressure value --) Or a lowest-blood-pressure value is presumed. Therefore, cuff pressure PC at the time of the waveform analysis value and pulse wave generating of the pulse wave of at least one beat obtained in the rapid pressure-up period of the cuff before the **** pressure-lowering period of a cuff 10 It is based, a living body's blood-pressure value is presumed, and a rough living body's blood-pressure value can be acquired quickly.

[0038] Moreover, according to this example, by SA22, since said living body's blood-pressure value is presumed based on two or more blood-pressure values, such as it, while two or more blood-pressure values are computed from two or more kinds of relation determined in SA12, the reliability of the blood-pressure value presumed is raised.

[0039] Moreover, it is based on the blood-pressure value which was presumed by the above SA 22 according to this example, and is the maximum pressure-up pressure PCMR of the rapid pressure up of a cuff 10. A maximum pressure-up pressure decision means 62 to determine (SA26), Pressure PC of a cuff 10 The maximum pressure-up pressure PCMR When reaching the cuff 10 since a compression pressure force-control means (pressure control valve 16) 54 to make **** pressure lowering of a cuff 10 start is established -- the rapid pressure-up period -- setting -- the maximum pressure-up pressure PCMR up to -- by carrying out a pressure up Since the pressure up of the cuff 10 is carried out to a value only with the predetermined additional coverage value alpha higher than necessity and sufficient value, i.e., a living body's highest-blood-pressure value, carrying out the pressure up of the cuff 10 to unnecessarily high **, or carrying out a re-pressure up is canceled, and the burden to a living body is mitigated suitably.

[0040] Moreover, an abnormality judging means 64 in blood pressure to judge a living body's abnormalities in blood pressure by comparing the blood-pressure value presumed by the above SA 22 with the decision-criterion value set up beforehand according to this example (SA24), When a living body's abnormalities in blood pressure are judged by the abnormality judging means 64 in blood pressure Since an abnormality display means (drop 38) 66 to display the abnormalities in blood pressure is established, in the rapid pressure-up period, a living body's blood-pressure value can know whether it is unusual, and the decision quick about the medical measures against a living body of a cuff 10 is attained.

[0041] Next, other examples of control actuation of said arithmetic sequence unit 26 are explained. In addition, the same sign is given to the portion which is common in the above-mentioned example in the following explanation, and explanation is omitted.

[0042] Drawing 14 is a functional block diagram explaining the control function of the arithmetic sequence unit 26 in this example. With the automatic blood-pressure-measurement equipment of drawing, if the compression pressure force

of a cuff 10 in which the pressure detection means 50 was wound around some living bodies is detected, the pulse wave detection means 70 will detect the pulse wave which is pressure vibration of the cuff 10 detected by the pressure detection means 50. This pulse wave detection means 70 supports the aforementioned band pass filters 22 or 23. The blood-pressure-measurement means 52 measures a living body's blood-pressure value based on change of the magnitude of the amplitude of a series of pulse waves generated when a cuff 10 is made to carry out **** pressure lowering. The compression pressure force-control means 54 will release the compression pressure force of a cuff 10, if **** pressure lowering is carried out and a blood-pressure value is determined in this **** pressure-lowering period, after carrying out a pressure up quickly to the maximum pressure-up pressure which was able to define the compression pressure force of a cuff 10 beforehand at the time of initiation of blood pressure measurement. The pulse wave amplitude cuff pressure storage means 72 carries out the sequential storage of the magnitude of the pulse wave detected by the pulse wave detection means 70, and the pressure of the cuff at the time of the pulse wave generating. The envelope decision means 74 determines the envelope showing relation with the pressure of a cuff when two or more the magnitude and two or more pulse waves of a pulse wave which were detected by the above-mentioned pulse wave detection means 70 in the rapid pressure-up period of the cuff 10 before blood pressure measurement are detected. The blood-pressure value presumption means 76 presumes said living body's blood-pressure value from the relation set up beforehand based on the envelope determined by the above-mentioned envelope decision means 74.

[0043] The above-mentioned envelope decision means 74 has asked for the envelope beforehand based on the amplitude of two or more pulse waves used at the time of the blood pressure measurement by the blood-pressure-measurement means 52, and the pressure of the cuff at the time of generating of the pulse wave. It is drawing the curvilinear pattern of a living body proper while it is a curve with a comparatively high precision, since this envelope for which it asked beforehand is based on comparatively many pulse waves generated at the time of blood pressure measurement. The blood-pressure value presumption means 76 newly creates the envelope which passes along the point which shows the amplitude of the pulse wave of the comparatively small number obtained in a rapid pressure-up period, and the pressure of the cuff at the time of the pulse wave generating, and determines a blood-pressure value based on the new envelope so that the curvilinear pattern of the same proper as the envelope for which it asked beforehand may be drawn. For example, like an oscillograph metric method, the cuff pressure corresponding to the maximum of the new envelope is determined as a mean-blood-pressure value, and the value of the low-tension side of the cuff pressures of the pair corresponding to the point of the new envelope inclining [maximum] and the value of the high-tension side are presumed as a lowest-blood-pressure value and a highest-blood-pressure value, respectively.

[0044] A maximum pressure-up pressure decision means 62 to determine the maximum pressure-up pressure of said rapid pressure-up period based on the blood-pressure value presumed by the above-mentioned blood-pressure value presumption means 76 is included further, and the compression pressure force-control means 54 makes **** pressure lowering of a cuff 10 start also in drawing 14, when the pressure of a cuff 10 reaches the maximum pressure-up pressure. Moreover, an abnormality judging means 64 in blood pressure to judge said living body's abnormalities in blood pressure by comparing the blood-pressure value presumed by the above-mentioned blood-pressure value presumption means 76 with the decision-criterion value set up beforehand, and an abnormality display means 66 to display the abnormalities in blood pressure when a living body's abnormalities in blood pressure are judged by the abnormality judging means 64 in blood pressure are included further.

[0045] Drawing 15 and drawing 16 are the flow charts explaining control actuation of the arithmetic sequence unit 26 in this example. In SB1 thru/or SB5 of drawing, like SA1 of above-mentioned drawing 4 thru/or SA5, after the rapid pressure up of the cuff 10 is carried out, it is judged whether the pulse wave inputted in the period made to carry out **** pressure lowering. Subsequently, the amplitude of the pulse wave inputted in SB6 and cuff pressure PC at the time of the pulse wave generating It memorizes in the pulse wave amplitude cuff pressure storage region 80 of RAM30 corresponding to said pulse wave amplitude cuff pressure storage means 72. And at SB7 corresponding to the blood-pressure-measurement means 52, blood pressure measurement is performed like SA7 of said drawing 4, and by continuing SB8 thru/or SB10, like SA8 of said drawing 4 thru/or SA10, if completion of blood pressure measurement is judged, while a blood-pressure value is displayed, pressure of a cuff 10 will be released.

[0046] The amplitude of the pulse wave of comparison-a large number extracted for blood pressure measurement at the completion time of the above-mentioned blood pressure measurement, and cuff pressure PC at the time of the pulse wave generating The amplitude of the pulse wave memorized in continuing SB11 in the pulse wave amplitude cuff pressure storage region 80 since it memorized in the pulse wave amplitude cuff pressure storage region 80, and cuff pressure PC at the time of the pulse wave generating Envelope H1 which passes the point shown, respectively As shown in drawing 17, it is determined beforehand. This envelope H1 Since [which was extracted for blood pressure measurement] it is comparatively formed based on many pulse waves, it is comparatively exact, and the curvilinear

pattern of a living body proper is shown.

[0047] In continuing SB12, it is judged whether it is continuation supervision mode like SA14. When decision of this SB12 is affirmed, while the same above-mentioned SB13 thru/or same above-mentioned SB18 as SA15 thru/or SA20 is performed and the rapid pressure up of the cuff 10 is carried out, it is judged whether the pulse wave was inputted in that rapid pressure-up period. The input signal about within the limits predetermined [decision / that the pulse wave was inputted in this SB18] in a pulse wave gap, for example, less than 20% of thing, is made into an object, and other things are removed as a noise. When decision of SB18 is affirmed, it sets to SB19, and they are the pulse wave amplitude and cuff pressure PC at that time. Envelope H2 which expresses the relation between the amplitude of the pulse wave at the time of a rapid pressure up, and the pressure of the cuff at the time of generating of the pulse wave in SB20 corresponding to said envelope decision means 74 after memorizing in the pulse wave amplitude cuff pressure storage region 80 It is determined. Envelope H1 determined in said SB11 in the envelope decision algorithm in this SB20 It is an envelope H2 by correcting that configuration so that the point which shows the amplitude of the above-mentioned pulse wave into which the curve of the same pattern was inputted at the time of a rapid pressure up, and the cuff pressure at the time of that pulse wave generating may be passed. It is determined. Drawing 18 (a) (b) (c) (d) Envelope H2 determined by making it such The example is shown, respectively.

[0048] Subsequently, envelope H2 at the time of the rapid pressure up determined in the above SB 20 in SB21 corresponding to said blood-pressure value presumption means 76 It is based and a living body's blood-pressure value is presumed. That is, it is the envelope H2 at the time of the rapid pressure up like an oscillograph metric method. The cuff pressure corresponding to maximum is determined as a mean-blood-pressure value, and it is the envelope H2. The value of the low-tension side of the cuff pressures of the pair corresponding to the point inclining [maximum] and the value of the high-tension side are presumed as a lowest-blood-pressure value and a highest-blood-pressure value, respectively.

[0049] It is judged in continuing SB22 whether presumption of a blood-pressure value was completed. Although said 17 or less SB is performed in order to read the further pulse wave when decision of this SB22 is denied When affirmed, the same SB23 thru/or same SB26 as SA24 thru/or SA27 of said drawing 5 is performed. When it is judged that blood pressure is unusual, while the contents of abnormalities are displayed on a drop 38, when it is judged that it is not unusual The maximum pressure-up pressure PCMR It is determined and is actual cuff pressure PC. The maximum pressure-up pressure PCMR If the value (PCMR+alpha) which applied ***** alpha is reached, said four or less SB will be performed again.

[0050] envelope H2 which expresses with this example relation with the pressure of the cuff 10 when two or more the magnitude and two or more pulse waves of a pulse wave which were detected by the pulse wave detection means 70 in the rapid pressure-up period of a cuff 10 are detected Envelope H2 which was determined by SB20 corresponding to the envelope decision means 74, and was determined by the SB20 from the relation beforehand set up by SB21 corresponding to the blood-pressure value presumption means 76 It is based and a living body's blood-pressure value is presumed. Therefore, envelope H2 which was obtained in the rapid pressure-up period of the cuff before the **** pressure-lowering period of a cuff according to the blood-pressure-measurement equipment of this example It is based, a living body's blood-pressure value is presumed, and a rough living body's blood-pressure value can be acquired quickly.

[0051] Moreover, since a noise is removed by limiting the object of decision of SB18 only to an input signal [predetermined in a pulse wave gap] within the limits according to this example, the reliability of the blood-pressure value presumed is raised.

[0052] Moreover, it is based on the blood-pressure value which was presumed by the above SB 21 according to this example, and is the maximum pressure-up pressure PCMR of the rapid pressure up of a cuff 10. A maximum pressure-up pressure decision means 62 to determine (SB25), Pressure PC of a cuff 10 When reaching PCMR+alpha, a compression pressure force-control means (pressure control valve 16) 54 to make **** pressure lowering of a cuff 10 start the cuff 10 since it is prepared -- the rapid pressure-up period -- setting -- the maximum pressure-up pressure PCMR up to -- by carrying out a pressure up Since the pressure up of the cuff 10 is carried out to a value only with the predetermined additional coverage value alpha higher than necessity and sufficient value, i.e., a living body's highest-blood-pressure value, carrying out the pressure up of the cuff 10 to unnecessarily high **, or carrying out a re-pressure up is canceled, and the burden to a living body is mitigated suitably.

[0053] Moreover, an abnormality judging means 64 in blood pressure to judge a living body's abnormalities in blood pressure by comparing the blood-pressure value presumed by the above SB 21 with the decision-criterion value set up beforehand according to this example (SB23), When a living body's abnormalities in blood pressure are judged by the abnormality judging means 64 in blood pressure Since an abnormality display means (drop 38) 66 to display the

abnormalities in blood pressure is established, in the rapid pressure-up period, a living body's blood-pressure value can know whether it is unusual, and the decision quick about the medical measures against a living body of a cuff 10 is attained.

[0054] As mentioned above, although one example of this invention was explained based on the drawing, this invention is applied also in other modes.

[0055] For example, in above-mentioned drawing 4 and the continuation supervision mode of the example of drawing 5, although it consisted of monitor cycles after it so that the relational expression might not be updated but it might be used once relational expression was determined in SA12 after the first blood pressure measurement, according to the period beforehand set up in continuation supervision mode, the above-mentioned relational expression may be made to be updated.

[0056] Moreover, the pulse wave extracted in the rapid pressure-up period of a cuff 10 in the above-mentioned example is the pressure PC of a cuff 10. Although inputted in the process in which it changes quickly It is the pressure PC of a cuff 10 at two or more kinds of pressures defined beforehand. It is the pressure PC of a cuff 10 so that it may be held. It is made to carry out a pressure up quickly stair-like, and is the pressure PC of a cuff 10. A pulse wave may be made to be inputted when held. If it does in this way, there is an advantage from which the configuration of a pulse wave is acquired much more correctly.

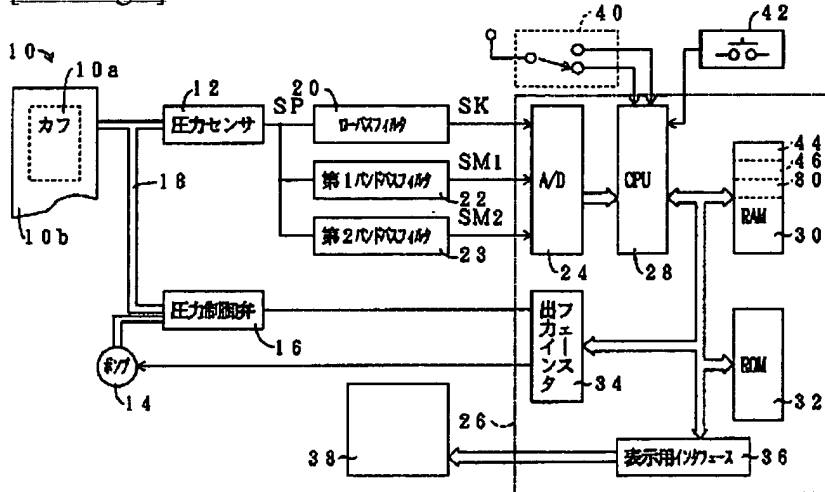
[0057] moreover -- SB21 of the example of above-mentioned drawing 16 -- envelope H2 from -- although the blood-pressure value was determined by the oscillometric method -- the envelope H2 from -- a blood-pressure value may be determined in simple. For example, drawing 18 (a) The line and the above-mentioned envelope H2 which show predetermined pulse wave amplitude value as shown in a dashed line It is one good also as a highest-blood-pressure value about an intersection.

[0058] In addition, having mentioned above is one example of this invention to the last, and various modification may be added in the range in which this invention does not deviate from the main point.

[Translation done.]

- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.**** shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

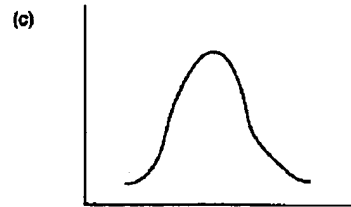
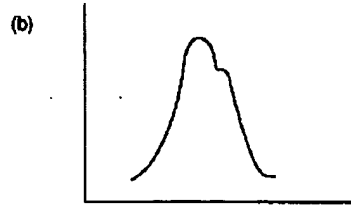
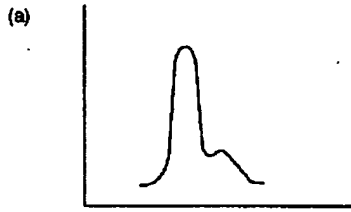
[Drawing 1]



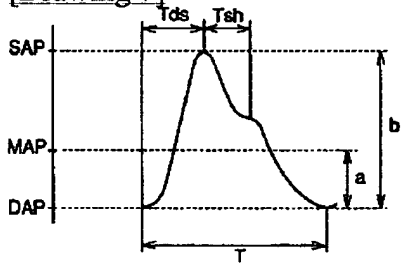
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graph TD
    10[カフ 10] --> 50[圧力検出手段 50]
    10 --> 54[脈波圧力制御手段 54]
    50 --> 52[血圧測定手段 52]
    50 --> 56[関係決定手段 56]
    50 --> 60[血圧値推定手段 60]
    54 --> 56
    54 --> 60
    56 --> 62[最大収縮圧力決定手段 62]
    56 --> 64[血圧異常判定手段 64]
    60 --> 64
    62 --> 66[異常表示手段 66]
    64 --> 66
  
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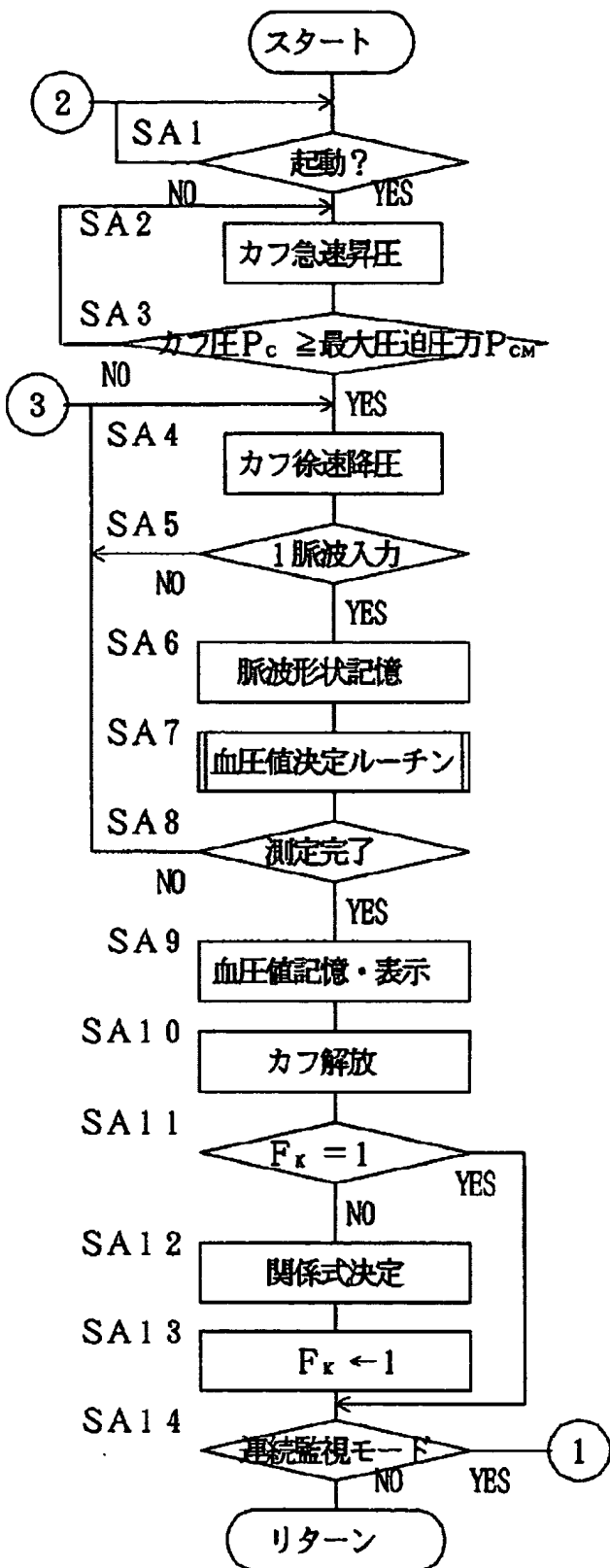
[Drawing 3]



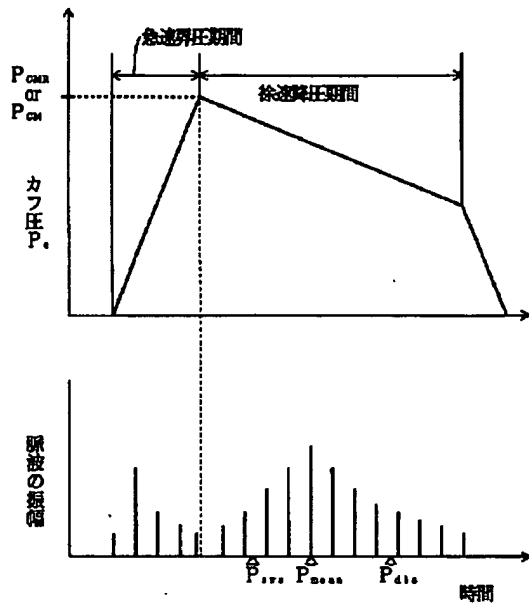
[Drawing 7]



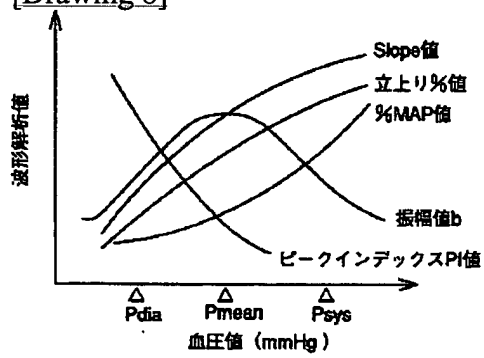
[Drawing 4]



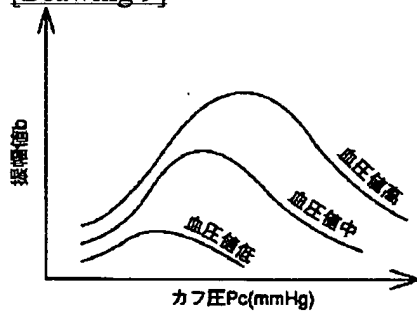
[Drawing 6]



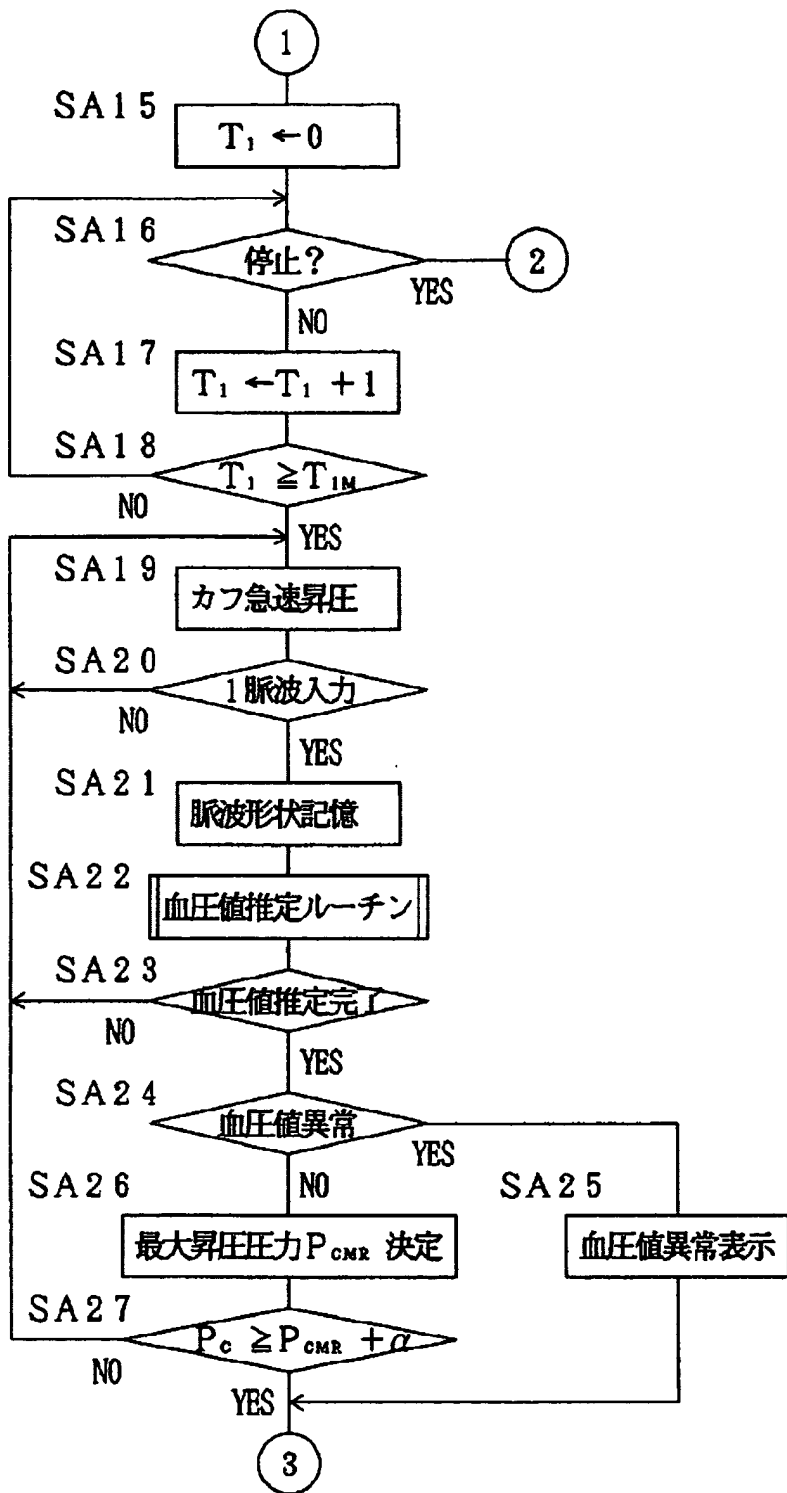
[Drawing 8]



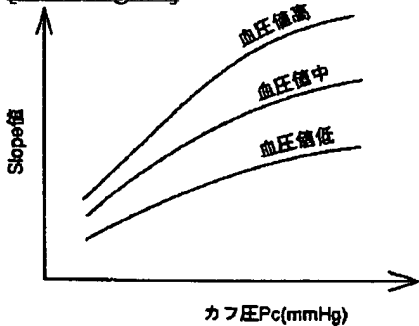
[Drawing 9]



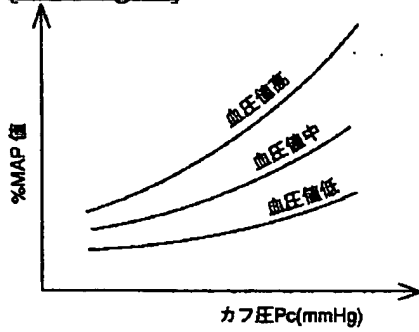
[Drawing 5]



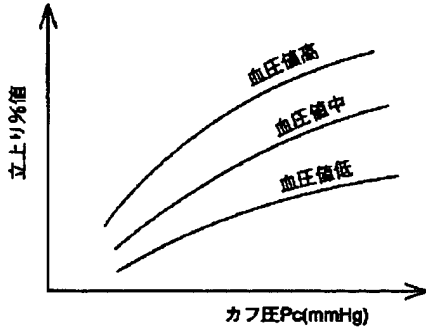
[Drawing 10]



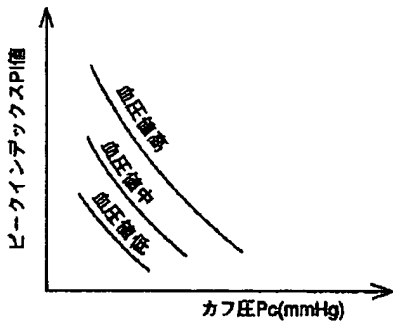
[Drawing 11]



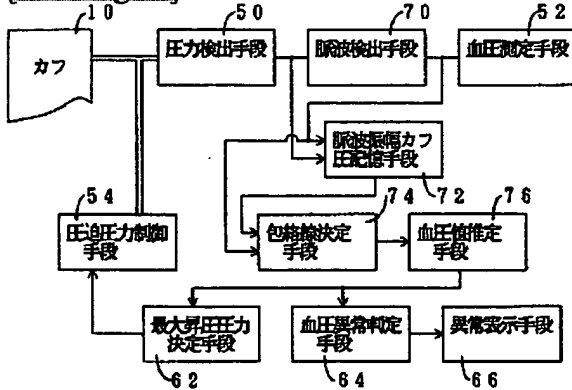
[Drawing 12]



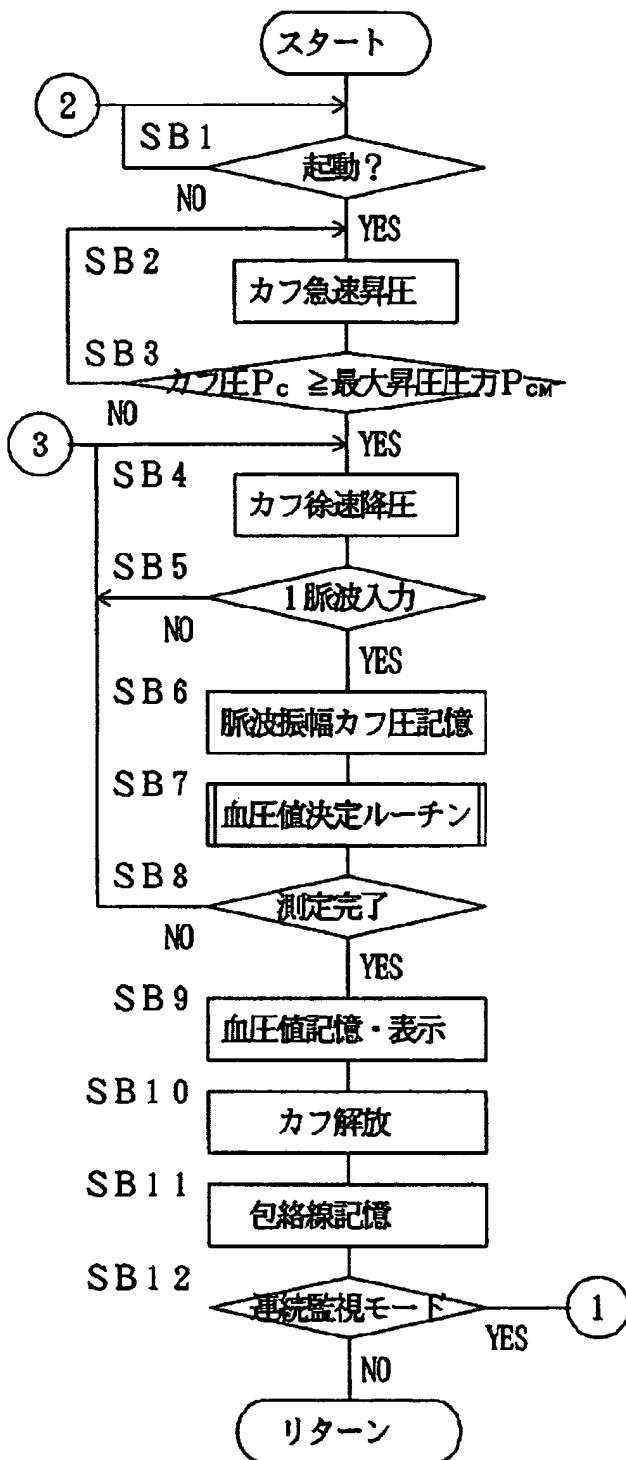
[Drawing 13]



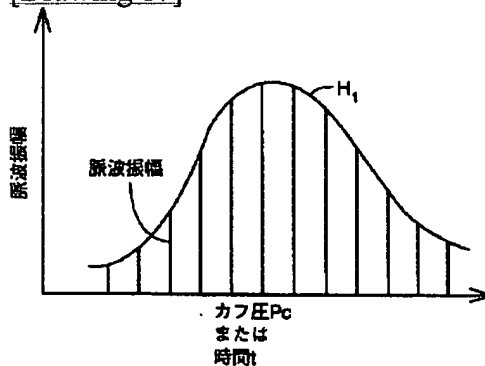
[Drawing 14]



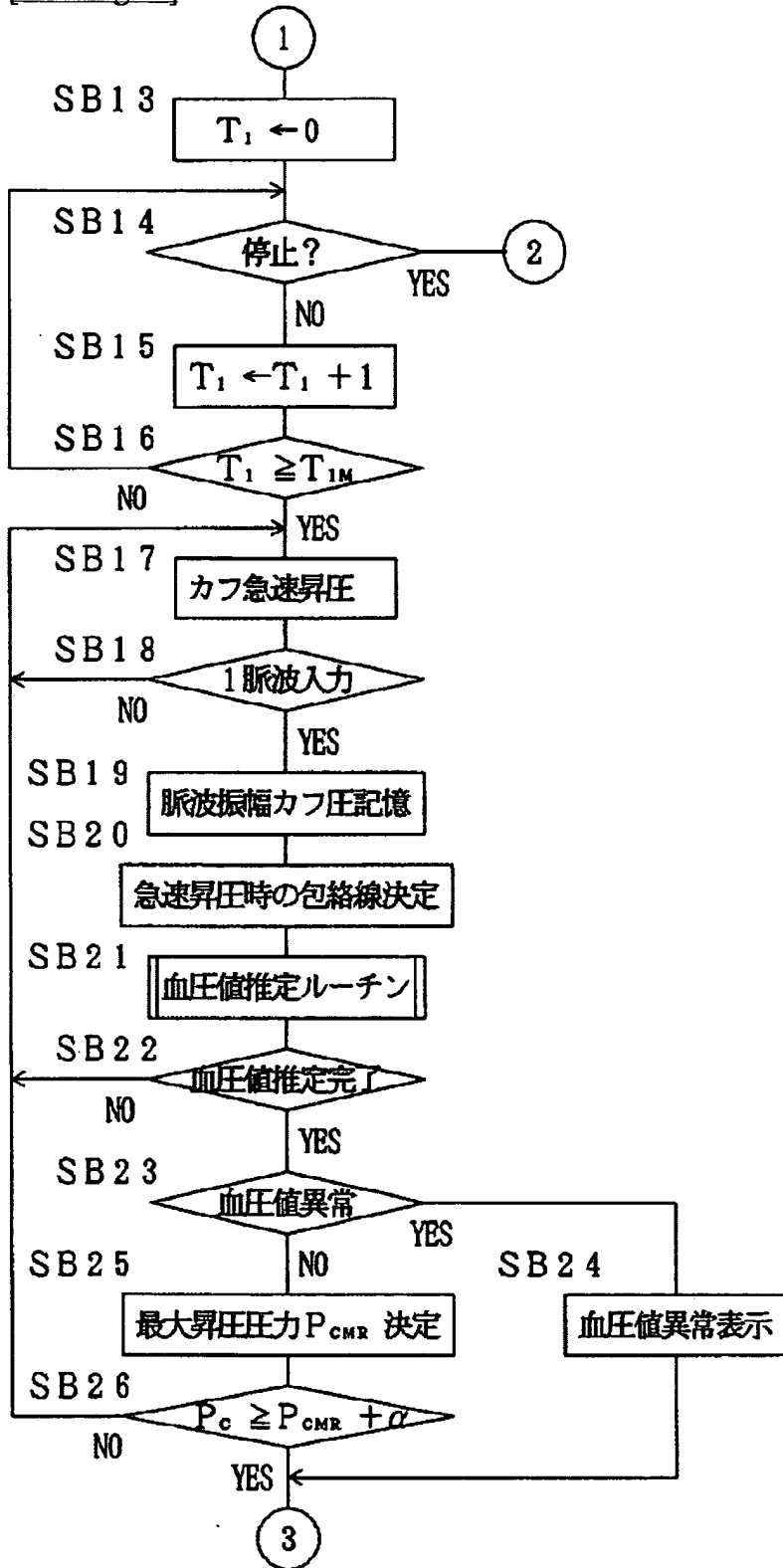
[Drawing 15]



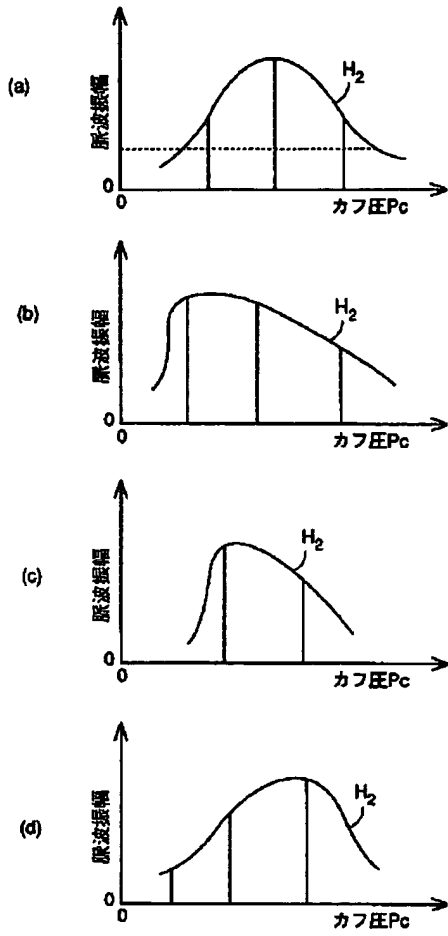
[Drawing 17]



[Drawing 16]



[Drawing 18]



[Translation done.]